

CLAIMS

1. A control system (1) including a plurality of control devices (5), each control device (5) including a control unit (2) and a display device (3) connected with said control unit (2) via a dedicated communication line (4) and being capable of display corresponding to a control state of said control unit, said control system (1) being capable of transmitting data between said control devices (5), wherein:

data are transmitted between said control unit (2) and said display device (3) according to a dedicated protocol specialized for said control unit (2); and

all of said display devices (3) in said control devices (5) are connected with each other via a common communication line (6), and data are transmitted between said display devices (3) according to a common protocol.

2. A control system (1a) as set forth in claim 1, wherein:

a data processing device (7) is connected to said common communication line (6); and

data are transmitted between said data processing device (7) and each display device (3) according to the common protocol.

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3. A control system (1c) as set forth in claim 2, wherein:

said control unit (2) is a programmable logic controller (2c) capable of performing a predetermined control operation by means of a program incorporated;

said display device (3) is a programmable display device (3c) capable of conducting display corresponding to control data of said control unit (2c); and

said data processing device (7) is a generally-used computer device (7c).

4. The control system (1) as set forth in claim 1, wherein:

said display device (3) forms a display by providing on one unit screen one or a plurality of processing instruction words (W) each defining a unit data processing operation, and effects the processing instruction word (W) at predetermined intervals, thereby enabling a predetermined display control operation;

the processing instruction word (W) causes addresses for storage of state data (MD) in all of said control devices (5) to be designatable as reference information (r), while in said display device (3) at which the processing instruction word (W) is effected, necessary data are sent via said common communication line (6)

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according to the common protocol to said display device (3) connected with said control device (5) designated as the reference information (r); and

said display device (3) having received the data cause necessary data to be transmittable to said control unit (2) connected therewith, according to protocol dedicated for said control unit (2) via dedicated communication line (4).

5. A display device (3b), comprising:

a first data communication port (11) connected with a control unit (2) having a predetermined dedicated communication protocol specialized for said control unit (2) itself;

a second data communication port (12) connected with a certain data processing device (5, 7);

a data processing section (13) that processes data inputted and outputted through said first and second data communication ports (11, 12), in accordance with a procedure set beforehand; and

a display section (14) that provides a display corresponding to information processed by said data processing section (13),

wherein:

said display device executes data communication with

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said control unit (2) according to the dedicated communication protocol of said control unit (2); and

said display device executes data communication with said data processing device (5, 7) according to the common communication protocol.

6. The display device (3b) as set forth in claim 5, wherein said data processing section (13) is also connected with an operating section (15), so that a timing of data processing and contents of the processing by said data processing section (13) can be manually instructed by means of said operating section (15).

7. A display device (3b) as set forth in claim 5, further comprising:

a data input section (12, 16) for downloading, from outside said device, data for communication according to the dedicated communication protocol.

8. A display device (3c) as set forth in claim 5, wherein:

said control unit (2) connected to said first data communication port (11) is a programmable logic controller (2c) capable of performing a predetermined control operation by means of a program incorporated; and

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said data processing device (5, 7) connected with said second data communication port (12) is a programmable display device (5) arranged substantially identically to said display device, said first data communication port of said programmable display device also being connected with a programmable logic controller (2c).

9. The display device (3c) as set forth in claim 8, wherein:

said data processing section (13) enabling a predetermined display control operation on said display section (14) by forming a display by providing one or a plurality of processing instruction words (W) each defining a unit data processing operation on one unit screen, and by effecting the processing instruction word (W) at predetermined intervals;

the processing instruction word (W) causes addresses for storage of state data (MD) in all of said programmable logic controllers (2c) to be designatable as reference information (r), while in each data processing section (13) at which the processing instruction word (W) is effected, necessary data are sent via said second data communication port (12) according to the common protocol to said display device (3c) connected with said

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programmable logic controller (2c) designated as the reference information (r); and

said display device (3c) having received the data causes necessary data to be transmittable to said programmable logic controller (2c) connected therewith, according to a protocol dedicated for said programmable logic controller (2c) via said first data communication port (9).

10. A display device (3d) as set forth in claim 5, further comprising:

a conversion table storing section (18a) that stores a conversion table showing correspondence between special information of said programmable logic controller (2c) that is extracted from the dedicated protocol on one hand and common information transmitted according to the common protocol on the other hand,

wherein said data processing section converts the common information received from said common communication line (6), into the special information, referring to said conversion table.

11. A display device (3d) as set forth in claim 10, further comprising:

a format information storing section (18b) for

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storing a data transfer format of transfer information transmitted according to the dedicated protocol,

wherein said data processing section produces the transfer information by substituting the converted special information for an undefined portion of the data transfer format.

12. The display device (3b) as set forth in claim 5, wherein:

said display section (14) and said data processing section (13) are provided in one case.

13. A display device (3e) as set forth in claim 5, further comprising:

a protocol determining section (13e) that:

sends out preset data according to a communication protocol selected from among a group of protocols applicable for communication of itself, prior to data transmission with said control unit (2); and

in the case where a response from said control unit (2) coincides with a predetermined response, determines the communication protocol as a communication protocol used for the data transmission with said control unit (2).

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14. A display device (3b), comprising:

a first data communication port (11) connected with a first control unit (2 $\alpha$ ) having a predetermined first communication protocol specialized for and dedicated for said first control unit (2 $\alpha$ );

a second data communication port (12) for enabling data communication with another display device (3 $\beta$ ) connected with a second control unit (2 $\beta$ ) having a predetermined second communication protocol specialized for and dedicated for said second control unit (2 $\beta$ );

a data processing section (13) that processes data inputted and outputted via said first and second data communication ports (11) and (12) in accordance with a procedure set beforehand;

a display section (14) that provides a display corresponding to information processed by said data processing section (13); and

an input section (16, 12) for inputting the first communication protocol from outside,

wherein data communication with said another display device (3 $\beta$ ) is executed according to a common communication protocol.

15. A data transmission method, applied when a data processing device (5) transmits data with a first data

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processing device (2) and a second data processing device (5, 7), said data processing device being provided between said first data processing device (2) and said second data processing device (5, 7), said first data processing device (2) transmitting data according to a first communication protocol, and said second data processing device (5, 7) transmitting data according to a second communication protocol, said method comprising:

a dedicated protocol communication step of transmitting data with said first data processing device (2) according to a communication protocol specialized for said first data processing device (2); and

a common protocol communication step of transmitting data with said second data processing device (5, 7) according to a communication protocol common to data processing devices (5, 7) that are likely connected with said data processing device (5).

16. A data transmission method as set forth in claim 15, further comprising:

a communication protocol converting step of converting the second communication protocol into the first communication protocol,

wherein:

said communication protocol converting step

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including the sub-steps of:

holding special information of said first data processing device extracted from the first communication protocol and information that is common among said second communication protocols corresponding to the special information, in a form of a conversion table (18a); and

converting common information sent from said second data processing device (5, 7) into special information of said first data processing device (2), referring to said conversion table (18a).

17. The data transmission method as set forth in claim 16, wherein:

said protocol converting step includes the sub-step of:

holding information (18b) about a data transfer format of transfer information transmitted with said first data processing device (2), and

said converting sub-step includes:

converting command data using common information supplied from said second data processing device (5, 7), into special information corresponding to the command data, by using said conversion table (18a); and

converting the converted special information into transfer information specialized for said first data

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processing device (2), by substituting the converted special information for undefined information portions of the data transfer format information (18b).

18. The data transmission method as set forth in claim 17, wherein:

in said common protocol communication step, communication is conducted with a plurality of said second data processing devices (5, 7) via a common communication line (6); and

in said dedicated protocol communication step, communication is conducted with said first data processing device (2) via a dedicated communication line (4).

19. A data transmission method, applied when a data processing device (5) transmits data with a first data processing device (2) and a second data processing device (5, 7), said data processing device being provided between said first data processing device (2) and said second data processing device (5, 7), said first data processing device (2) transmitting data according to a first communication protocol, and said second data processing device (5, 7) transmitting data according to a second communication protocol, said method comprising:

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a dedicated protocol communication step of transmitting data with said first data processing device (2) according to a communication protocol specialized for said first data processing device (2);

a data sending step of, prior to said dedicated protocol communication step, selecting a communication protocol from among a group of protocols possessed by itself and sending out preset data according to the selected communication protocol; and

a protocol determining step of waiting for a response from said first data processing device (2), and determining a communication protocol to which a predetermined response is obtained as a communication protocol used for data transmission with said first data processing device (2).

20. The data transmission method as set forth in claim 19, wherein:

in said data sending step, a predetermined command to which any response data can be obtained from said first data processing device (2) side is sent out as the preset data.

21. The data transmission method as set forth in claim 20, wherein:

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in said data sending step, a command that uniformly specifies a communication protocol applied is sent out, depending on the command sent to said first data processing device (2) and the response data to the command.

22. The data transmission method as set forth in claim 21, wherein:

the command sent to said first data processing device (2) in said data sending step causes a certain error to said first data processing device (2); and

the response data returned in said protocol determining step from said first data processing device (2) having received the command enable determination of a type of the communication protocol.

23. A data transmission method as set forth in claim 19, further comprising:

a common protocol communication step of transmitting data with said second data processing device (5, 7) according to a communication protocol common to data processing devices (5, 7) that are likely connected with said data processing device (5); and

a real-time data converting step of converting the data transmitted according to the common protocol, at

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real time according to the first communication protocol so that data are transmitted with said first data processing device (2) in said dedicated protocol communication step.

24. A control-use host computer (7f), used in a control system (1) that includes:

a control unit (2) for controlling a control target (9);

a display device (3) that communicates with said control unit (2) via a dedicated network (4) so as to display or control a control state of said control unit (2) and that, in the case where a common network (6) apart from said dedicated network (4) has a communication protocol different from that of said dedicated network (4), converts one of the protocols into the other protocol; and

said control-use host computer (7) connected with said display device (3) via said common network (6),

said control-use host computer (7) comprising:

an interface section (51) that sends data streams containing instruction contents for said control unit (2) via said common network (6) to said display device (3) connected with said control unit (2).

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25. The control-use host computer (7f) as set forth in claim 24, further comprising:

a plurality of transmission control sections (57, 58) that are provided between said interface section (51) and a host-side display section (52a through 52d) for controlling or displaying a state of said control target (9) and that controls said interface section (51) in response to a request from said host-side display section (52a through 52d), so as to transmit or receive data for controlling or displaying the state of said control target (9),

wherein:

one of said transmission control sections (57, 58) is a simple transmission control section (58) that is capable of specifying the request through a simpler procedure than the other transmission control section (57) does.

26. A control system (1g) in which a control device (5) controls a control target (9) in response to a control output transmitted from a host device (7), and transmits information about the control to a display device (3) so that the information is synthesized and displayed with character and image data installed beforehand in said display device (3),

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wherein:

said display device (3g $\alpha$  through 3g $\gamma$ ) is provided between said host device (7g) and a control unit (2c $\alpha$  through 2c $\gamma$ ), so that the character and image data are downloaded from said host device so as to be installed in said display device.

27. The control system (1g) as set forth in claim 26, wherein:

communication between said control unit (2c $\alpha$  through 2c $\gamma$ ) and said corresponding display devices (3g $\alpha$  through 3g $\gamma$ ) is carried out according to a certain protocol, while communication through a network circuit (6) between said display device (3g $\alpha$  through 3g $\gamma$ ) is carried out according to a common protocol determined beforehand.

28. A control system (1h) in which a plurality of control units (2) respectively control control targets (9) in response to control outputs transmitted from a host device (7), and information about the controls is displayed in corresponding display devices (3), respectively,

wherein:

said display device (3h $\alpha$  through 3h $\gamma$ ) is provided between said host device (7g) and said control unit (2c $\alpha$

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through 2cy), so that preset data are downloaded from said host device (7g) so as to be installed in said display device.

29. The control system (1h) as set forth in claim 28, wherein:

communication between said control unit (2cα through 2cy) and said corresponding display devices (3hα through 3hy) is carried out according to a certain protocol, while communication through a network circuit (6) between said display device (3hα through 3hy) and said host device (7g) is carried out according to a common protocol determined beforehand.

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